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PATENT SPECIFICATION

1,110,534

DRAWINGS ATTACHED

1,110,534

Inventor: PETER FRANKLIN HARRISON

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Int. Cl.:—B 29 f 1/06

COMPLETE SPECIFICATION

Improvements in or relating to Injection Moulding Machines and processes

We, PECO MACHINERY LIMITED, a British Company, of Riverside Works, Corney Road, Chiswick, London, W.4, and PETER FRANKLN HARRISON, a British Subject, of Peco Machinery Limited, Riverside, Works, Corney Road, Chiswick, London, W.4, (formerly of The Projectile & Engineering Company Limited, Thessaly Road, Battersea, London, S.W.8), do hereby declare the invention, for which we pray that a patent may be granted to us, and the method by which it is to be performed, to be particularly described in and by the following statement:—

This invention relates to injection moulding machines and processes.

According to this invention an injection moulding machine comprises a pair of platens carrying parts of a multi-part mould defining within itself a mould cavity, reducing the volume to a predetermined minimum value, a reciprocatable plunger operable to inject on a working stroke a metered quantity of thermoplastic material into the mould cavity, and means operative in dependence on the instantaneous position of the plunger in its working stroke to vary the injection pressure exercised by the plunger on the material and to control a mould part moving means either to reduce the volume of the mould cavity to said predetermined minimum value or to increase or permit the increase of the volume of the mould cavity and subsequently to reduce the volume of the mould cavity to said predetermined value. The variation of the injection pressure and of said volume as the plunger moves along its working stroke may be accomplished in a plurality of steps or continuously.

The means for moving the mould parts relative to each other preferably comprises a piston and cylinder hydraulic motor, and in this case, the variations of the volume of the mould cavity can conveniently be accomplished by appropriate adjustment of the pressure of the fluid supplied to said cylinder.

Limit switches operable by the plunger, or by an element which moves with the plunger, during the working stroke of the plunger may be provided to initiate step-wise variations of the injection pressure and said volume. Alternatively, it may be arranged that movement of the plunger during its working stroke controls a transducer *e.g.* a potentiometer, giving an electrical signal dependent on the position of the plunger. This signal may be arranged to give continuous variation of the injection pressure and of said volume. Means may be provided for predetermining the relationship between the plunger position and the injection pressure and/or mould volume. For example, the amount of said variation of the injection pressure and/or of said volume occuring at the various instantaneous positions of the plunger in its working stroke may be determined by means which is controlled by punch-card or by the adjustment of datum-setting electrical circuits, or model curves and may be accomplished by using suitable parameters.

Thus time may be employed as a parameter representative of the position of the plunger during its working stroke, if desired.

The mould may comprise two parts which are respectively mounted on the two platens and which engage one another telescopically so as to provide a mould cavity of variable size. The two mould parts may be arranged to come into abutment in relative positions such as to define the size of the article to be moulded. Alternatively the mould may comprise three parts, two of which are mounted on the respeotive platens and the third of which is slidably mounted centrally or generally centrally within one of said two mould parts so as to be disposed within the periphery of the article to be moulded. In this alternative construction, said two mould parts are movable towards and away from each other and held together by any suitable means, and the third mould part, which defines part of the mould cavity, has a variable pressure applied to it tending to urge the third mould part into a

– Standard Spritzgießverfahren

→ beim Einspritzen und vollständigen Auffüllen wird die

1110534 COMPLETE SPECIFICATION

1 SHEET *This drawing is a reproduction of the Original on a reduced scale*

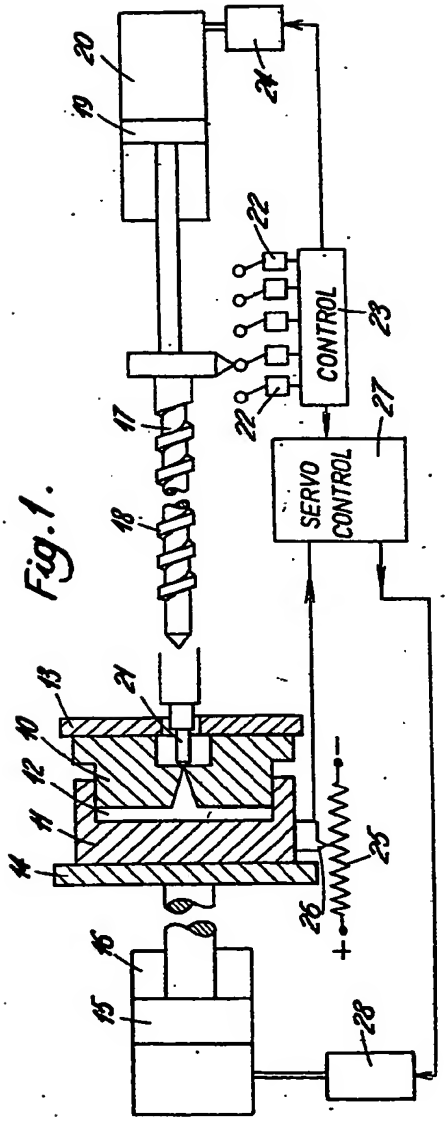

Fig. 1.

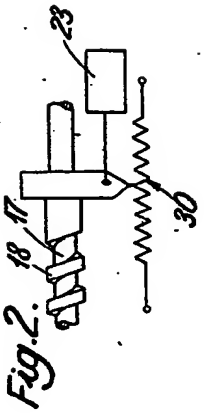

Fig. 2.

position in which the cavity is of a predetermined minimum size corresponding to the shape of the final moulded article, and this pressure is varied in dependence on the position of the plunger in its working stroke to reduce the size of the mould cavity to the predetermined minimum or to increase or permit the increase of the volume of the mould cavity and subsequently to reduce the volume of the mould cavity to said predetermined value.

The invention also includes a method of producing an injection moulding, which method comprises injecting a metered quantity of thermoplastic material into a mould cavity whilst varying the injection pressure applied during a working stroke of an injection plunger and either reducing the volume of the mould cavity to a predetermined minimum value during the working stroke of the plunger or increasing or permitting the increase of the volume of the mould cavity and subsequently reducing the volume of the mould cavity to said predetermined minimum value, the variations of injection pressure and mould cavity volume being controlled in dependence on the instantaneous position of the plunger in said working stroke. Said variations may be in step-wise or continuous relation to the movement of the plunger *i.e.* to the displacement of the plunger from its initial position through the working stroke.

In the following description, reference will be made to the accompanying drawings in which:—

Figure 1 is a diagrammatic representation of part of an injection moulding machine; and

Figure 2 is a diagram illustrating a modification of the machine of Figure 1.

Referring to Figure 1, there is illustrated diagrammatically an injection moulding machine in which a two part mould 10, 11 defines a mould cavity 12. The mould part 10 is carried on a fixed platen 13 whilst the mould part 11 is carried on a moving platen 14, movement of which is effected by a piston 15 in a cylinder 16. The mould parts 10, 11 engage one another telescopically so that the volume of the mould cavity can be controlled by control of hydraulic fluid fed to the cylinder 16. Injection of thermoplastic material into the mould cavity is effected by a plunger 17 which is both rotatable and reciprocatable, rotation of the plunger enabling a metered quantity of the material to be fed forwardly, by means of the helical flights 18 on the plunger, so that, when the plunger is moved forwardly by a piston 19 in a cylinder 20, the material is injected through a nozzle 21 into the mould cavity 12.

As the plunger moves forwardly on the injection stroke, it operates a number of switches 22 in succession. These switches are electrically connected to a control unit 23 which, by means of an electrically controlled valve 24 in a pressure fluid supply line to the cylinder 20 adjusts the pressure applied to the piston 19 and hence the injection pressure in a number of successive steps during the working stroke.

A potentiometer 25 has a movable tap 26 which is positioned in accordance with the position of the movable mould part 11. The potentiometer thus provides an electrical signal representative of the mould volume which signal is used as a feedback signal for a servo control unit 27, controlling by means of a valve 28, the fluid flow to the piston 16. The servo control unit 27 thus controls the position of the movable die part and, under the control of the switches 22, does this in steps during the injection stroke of the plunger.

For each step of the working stroke of the plunger, as sensed by operation of the successive switches 22, the control unit 23 determines the required injection pressure and the required mould volume. The relationships between the successive switch operations and the injection pressure and mould volume may readily be pre-determined or controlled by the choice of appropriate circuit parameters or by a punch-card controller or in other known ways. The relationships to be employed will depend on the article to be moulded and the type of material used. It may be required, for example, to have the mould cavity initially larger than the final volume and to inject the quantities of material sufficient to fill the final volume of the mould cavity, then to reduce the cavity to this volume so as to get a compression moulding. The above described apparatus enables the mould volume to be controlled, if necessary overcoming any tendency for the volume to increase due to the injection pressure applied to the material. The injection pressure may, for example, be increased and subsequently decreased in stages during the working stroke.

Figure 2 illustrates a modification of the apparatus of Figure 1 in which the position of the plunger 17 is sensed by a potentiometer 30 providing an output which varies continuously during the working stroke and which is fed to the control unit 23 which can now give a continuous instead of a step-wise control of the injection pressure and the mould volume. It will be appreciated that other devices may be used both for sensing the position of the plunger and of the movable mould part. Moreover, since the injection stroke is continuous and uni-directional, a timing device may be used for giving outputs representing the movement of the injection plunger.

The step-by-step or continuous variation of the injection pressure and the step-by-step or continuous variation of the size of the mould cavity both in dependence on the position of the plunger as it advances through its working stroke, have been found to be advantageous in permitting an injection moulding machine to be employed for making mouldings which by reason of their size are outside the scope

of the machine when operated in the conventional manner.

WHAT WE CLAIM IS:—

1. An injection moulding machine comprising a pair of platens carrying parts of a multi-part mould defining within itself a mould cavity, reducing the volume to a predetermined minimum value, a reciprocatable plunger operable to inject on a working stroke a metered quantity of thermoplastic material into the mould cavity, and means operative in dependence on the instantaneous position of the plunger in its working stroke to vary the injection pressure exercised by the plunger on the material and to control a mould part moving means either to reduce the volume of the mould cavity to said predetermined minimum value or to increase or permit the increase of the volume of the mould cavity and subsequently to reduce the volume of the mould cavity to said predetermined value.

2. An injection moulding machine as claimed in claim 1 wherein the means for moving the mould parts relative to each other comprises a piston and cylinder hydraulic motor.

3. An injection moulding machine as claimed in either claim 1 or claim 2 wherein said means operative in dependence on the instantaneous position of the plunger comprise limit switches operable by the plunger or by an element movable with the plunger during the working stroke of the plunger to initiate step-wise variations of the injection pressure and said volume.

4. An injection moulding machine as claimed in either claim 1 or claim 2 wherein said means operative in dependence on the instantaneous position of the plunger comprises a transducer giving an electrical signal dependent on the position of the plunger.

5. An injection moulding machine as claimed in claim 4 wherein said transducer is a potentiometer.

6. An injection moulding machine as claimed in any of the preceding claims wherein means are provided for predetermining the relationship between the plunger position and the injection pressure and/or mould volume.

7. An injection moulding machine as claimed in any of the preceding claims wherein the mould comprises two parts which are respectively mounted on the two platens and which engage one another telescopically.

8. An injection moulding machine as claimed in any of claims 1 to 6 wherein the mould comprises three parts, two of which are mounted on the respective platens and the third of which is slidably mounted centrally or generally centrally within one of said two mould parts so as to be disposed within the periphery of the article to be moulded.

9. A method of producing an injection moulding which method comprises injecting a metered quantity of thermoplastic material into a mould cavity whilst varying the injection pressure applied during a working stroke of an injection plunger and either reducing the volume of the mould cavity to a predetermined minimum value during the working stroke of the plunger or increasing or permitting the increase of the volume of the mould cavity and subsequently reducing the volume of the mould cavity to said predetermined minimum value, the variations of injection pressure and mould cavity volume being controlled in dependence on the instantaneous position of the plunger in said working stroke.

10. A method as claimed in claim 9 wherein the variations of injection pressure and mould cavity volume are effected in steps.

11. A method as claimed in claim 9 wherein the variations of injection pressure and mould cavity volume are continuous as the plunger moves from its initial position through the working stroke.

12. A method of producing an injection moulding machine substantially as hereinbefore described.

13. An injection moulding machine substantially as described with reference to the accompanying drawings.

BOULT, WADE & TENNANT,
111 & 112, Hatton Garden, London, E.C.1.,
Chartered Patent Agents,
Agents for the Applicants.

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